DIGITAL COMPUTER NEWSLETTER

The purpose of this newsletter is to provide a medium for the interchange, among interested persons, of information concerning recent developments in various digital computer projects.

OFFICE OF NAVAL RESEARCH • MATHEMATICAL SCIENCES DIVISION

Vol. 5, No. 2 April 1953

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Approved by
The Under Secretary of The Navy
27 August 1951

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NAVAL PROVING GROUND CALCULATORS

During the past three months the Mark III Calculator and the Aiken Relay Calculator (Mark II) have continued to operate on a 24-hour per day schedule.

The operating efficiency of the Mark II continues at about 85 per cent. That of the Mark III has shown a substantial improvement. The average over the past four weeks was 82 per cent, the most successful record for any similar period. During this period an efficiency of 89 per cent was obtained for one week. It is believed that improved preventive maintenance techniques and a more experienced operating staff are large factors contributing to the better performance.

Additional checking facilities have been designed by the Computer Research and Development Group for the Mark III Calculator and are now being installed. Further refinements are in progress and will be installed from time to time in the near future.

In addition to the usual heavy program of ballistic computation performed on the Calculators during the past quarter, a problem involving computations of Radar Cross Sections of a Prolate Spheroid was completed for the Willow Run Research Center, the University of Michigan.

WHIRLWIND I

During the period 1 December 1952 to 1 March 1953, a total of 781 programs (exclusive of military applications) were run.

Of interest among the scientific and engineering problems handled by the computer were: (1) earth resistivity interpretations, MIT geology and geophysics department, (2) deuteron binding energy and wave functions, MIT physics department, (3) transient aerodynamic heating of a flat plate, aero-elastic and structures laboratory, (4) Lawley's method of factor analysis, characteristic vectors (modified); educational testing service, research department, (5) optical properties of thin metal films, MIT chemistry department.

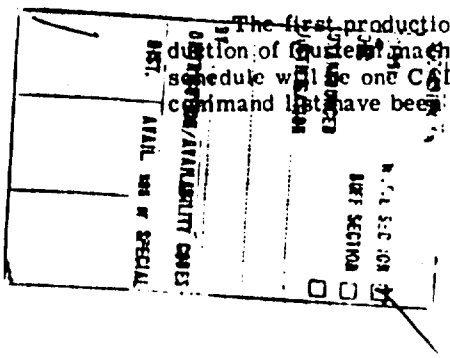
A comprehensive system of service routines using perforated paper tape as auxiliary storage has been in use during the above period of time. However, further development and refinement of this system continues. In particular the system has now been modified to use two magnetic tape units as auxiliary storage. The use of the magnetic drum as further auxiliary storage is being studied. These forms of auxiliary storage greatly reduce the amount of time taken by conversion.

In addition to the features discussed in the January 1953 Newsletter, the comprehensive system now includes the automatic selection of output routines. The programmer obtains the desired form of output by writing at the proper point of his program a sample number preceded by three letters which indicate essentially the output medium required (typewriter, punch, magnetic tape, or numeriscope).

A course is now being offered monthly to provide qualified persons with necessary training for programming on WWI. In addition, a seminar is being conducted for discussion of advanced programming techniques.

THE COMPUTER RESEARCH CORPORATION COMPUTERS

CADAC 102-A



The first production CADAC 102-A is to be completed approximately 25 May 1953. Production of [illegible] machines has been initiated, and by the summer of 1953 the production schedule will be one CADAC 102-A completed every eight working days. Two additions to the command list have been made since the October 1952 Newsletter report:

(1) Alphabetic mode of print command enabling any character on the Flexowriter to be printed by programming the proper groups of six binary digits or two octal digits within the computer itself.

(2) A test search command enabling the computer to discover whether a magnetic tape unit is still searching or not. This is a transfer of control command.

CRC 105

The first CRC 105 Decimal Digital Differential Analyzer has been delivered, and the next three are in final test. Various types of problems have been run on the first machine, including interior ballistics research problems, partial differential equation solution by net relaxation, trajectory problems and a molecular crystal growth chemical problem.

CRC 107

The first two models of the CRC 107 are in final test and performance to date has been very good. Experience with the engineering prototype magnetic tape unit indicates that high reliability will result from the use of double channel recording and the use of wide channels for reduction of dust and blemish troubles. Twenty-two magnetic tape units are in various stages of production with the first production unit nearly complete.

MOORE SCHOOL AUTOMATIC COMPUTER (MSAC)

Preliminary specifications for the MSAC power supply and power distribution system, and for sources of one megacycle and eight megacycle sine waves have been completed, as well as the schematics of the chassis for the main body of the MSAC. Construction is continuing on the timer unit, and a small production line is being used to fabricate the pulse transformers for MSAC.

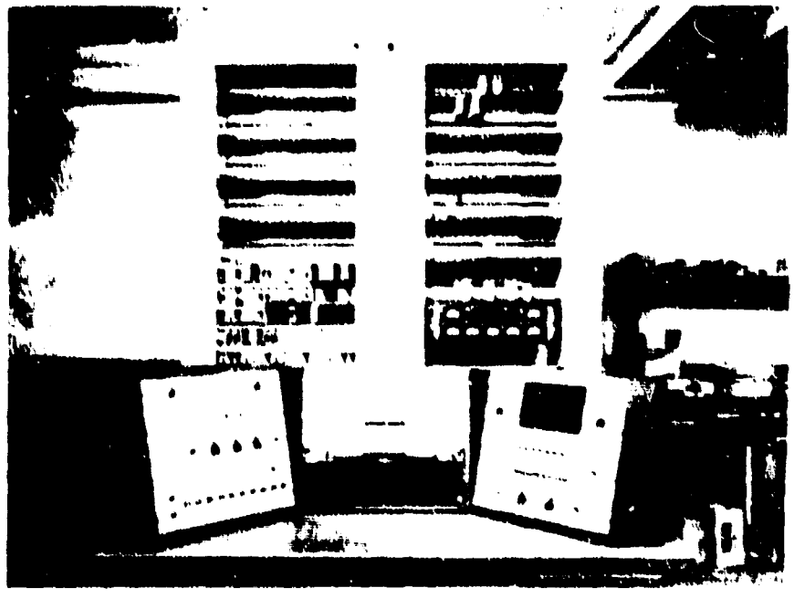
AIR FORCE MISSILE TEST CENTER COMPUTER (FLAC)

The Florida Automatic Computer (FLAC), Fig. 1, Patrick Air Force Base, Florida, is in the final stages of debugging. The machine, which has a word length of 44-binary digits plus sign, operates with a floating three-address operation code (i.e. the specified addresses may be either absolute or relative to either the program counter or special "B" register). Operations it performs include: addition, subtraction, multiplication (rounded and unrounded, high- or low-order results available), division (remainder available), complete decimal-binary and binary-decimal conversion, logical transfer, shift, equality sensing, comparison and file.

The present 512-word mercury-delay-line memory is capable of expansion to 4000 words with four 500-word-per-minute tape units providing external memory. The external memory units operate with permanently recorded block marks for hunting, as well as facilities for altering any block of data stored on an external memory tape.

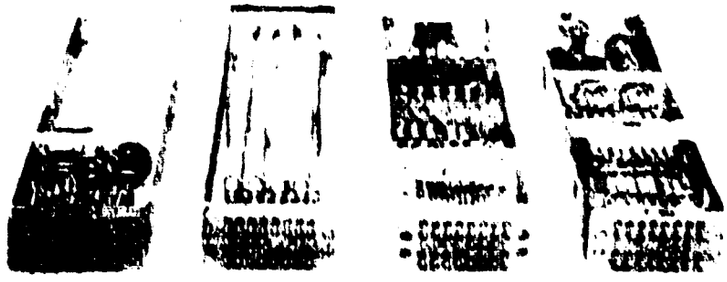
Operating speeds and circuit philosophy resemble the Bureau of Standards SEAC. However, the machine employs only 380 tubes plus an additional 350 for each 512 words of acoustic-delay-line memory. The machine employs seven basic plug-in assemblies which contain all circuit elements (see Fig. 2). Built-in refrigeration provides for parallel cooling of all components, thus insuring long life and improved machine operation.

A comparison-type problem preparation unit and automatic format output printer, designed around a Flexowriter machine, has been placed in operation. The central control and input-output circuits for the computer are operational, and debugging is progressing through the arithmetic unit and high-speed memory.



FLAC - Florida Automatic Computer
Patrick Air Force Base, Florida

View of temporary control console, computer and magnetic wire input dumper



FLAC - Florida Automatic Computer
Patrick Air Force Base, Florida

Plug-in package types - Left-to-Right:

1. Spare Diode
2. Delay line - 16 - 1/4 μ sec. sections
3. Delay Line Termination
4. Amplifier and Diode gating package

THE SEAC

The three-address mode of operation, whose circuitry was installed and checked by coding and running a check routine and prime number routine, is now available for regular operation on SEAC, along with the four-address system. A multi-channel tape drive and its associated circuitry have been completely checked out, and the unit is operating as an integral part of the input-output equipment. A magnetic wire dumper, capable of both input and output operation, has also been constructed and installed. Engineering time during the past several months was devoted primarily to modifying the circuitry associated with the experimental Williams type memory and running evaluation tests.

Installation of regulated d-c power supplies and a-c regulators is underway to eliminate the low voltage and poor regulation which have been adversely affecting the over-all operating efficiency of SEAC. In addition, a closed-circuit air cooling system is being installed to provide a constant and somewhat lower ambient temperature within the computer.

In order to establish a more systematic method for trouble-shooting such a complicated machine and to enable inexperienced technical personnel to isolate troubles more readily, a number of new diagnostic test routines have been written and several of the old routines improved. Reliable tests are now available for diagnostic checking of all parts of the machine, including the input-output units.

Average "good" operating time for the past six months of 1952 was slightly over 75 per cent of total assigned time for a 168-hour week, good time being defined as time during which problem solutions and code checking were turned out correctly plus time during which the computer was in good operating condition but idle. This compares more than favorably with the 65 per cent figure for the previous quarter.

THE IAS COMPUTER

From October 1952 through February 1953 the IAS machine has been on an 80-hour week, of which about 20 hours have been devoted to engineering and 10 to scheduled maintenance. The machine is available for computation about 50 hours per week and operates error free about 64% of this time. All calculations are done twice and exact duplication of results is required.

During this period a variety of problems have been solved or are currently being undertaken. They include a large number of meteorological forecasts, several hydrodynamical calculations, a number of astrophysical calculations, some work on the determination of quantum-mechanical wave functions, a mathematical application of biology, and some determinations of the eigenvalues and associated functions of symmetric matrices.

Forty-channel IBM input-output equipment has been added to the machine, replacing the teletype units previously used, and a 514 reproducing punch has been associated with the machine for this purpose. Twelve words of 40 binary digits each are stored on a card and are handled at 100 cards per minute.

A magnetic drum of 2000-word capacity is now under development.

THE SWAC

The operating efficiency of the SWAC has continued to increase during the past few months. At present useful computing averages between 65 per cent and 70 per cent of the total operating time, scheduled maintenance and testing about 15 per cent, adjustment and checking of the electrostatic memory 10-15 per cent, and out-of-order maintenance about 5 per cent.

Work on the project of adding a magnetic drum memory to the SWAC continues. The magnetic drum memory control circuits, together with selection matrices for reading and writing, have been built and checked out. Construction of synchronizing circuits between the SWAC computer and the drum memory is underway.

Experimental work on a modified version of the Williams' type of electrostatic memory continues and initial results promise a substantial improvement both in read-around ratio and insensitivity to flaws.

During the last quarter over 600 hours of computation were performed on some twenty problems of widely varying type. Descriptions of these problems and the progress toward their solution are available in the quarterly reports of Projects and Publications of the National Applied Mathematics Laboratories, National Bureau of Standards.

MONROBOT

The Monrobot Corporation is to take over all functions of the Electronic Research and Development Department, as a subsidiary of the Monroe Calculating Machine Company, Orange, New Jersey. Three MONROBOTS are now under construction, one undergoing final tests prior to delivery to a defense activity, a second is being assembled for use as a demonstrator and to establish a calculating service, and a third for another defense activity is under construction. Magnetic drums are employed for fast-access memory, perforated tape for additional, slow-access economical storage. Results are printed at ten characters per second on rolls of paper 8-1/2" wide, tabulated as required. The entire calculator occupies a metal desk-size cabinet with built-in air cooling facilities for the 700 tubes employed. A simple manually operated keyboard is provided for the initial programming and factor-inserting operation.

Programs and numbers—20 decimal digits in length, with the decimal point in the middle—are read in from perforated paper tape to the magnetic drum, and results can be printed and punched. In printing and in transferring to or from paper tape, digits may be eliminated, as desired, on the left or right. The MONROBOT is designed as an all-purpose calculator, performing addition, subtraction, multiplication, division, comparison, and automatic modification of orders. Its power consumption is less than 3000 watts from a 110-volt AC line. It weighs less than 2000 pounds. The MONROBOT made its public debut on the night of November 4, 1952, when it was moved into the Radio City, New York television studios for use on the TV broadcast of the national election results over the NBC network.

THE CIRCLE COMPUTER

Final assembly of the first production model of the Circle Computer was scheduled for completion early in April 1953, to be followed by debugging and reliability checking.

THE JACOBS INSTRUMENT COMPANY COMPUTERS (JAINCOMPS)

Progress continues on the construction of JAINCOMP-C, a high-speed real-time control computer of the all-parallel, all-electronic JAINCOMP variety. It has a basic addition time of 8 microseconds. Its program is controlled by an electronically scanned punched card, from which any 3-address order can be read in 1 microsecond. The machine has five different types of storage, totaling 231 24-digit words (5544 bits). Access time for some types of storage is 1 microsecond; for other types 4 microseconds. Automatic checking facilities are included. The entire computer, complete with its multiplicity of input and output channels (but exclusive of the punched-card holders) fits in a cabinet 27-9 16 x 24-1/8 x 22 in. (8.5 cu ft). This cabinet contains a forced-air cooling system. All circuits are of the plug-in variety, and are replaceable in thirty seconds.

Work has continued at a low level on the logical design of JAINCOMP-D, an unusually versatile general-purpose computer which will be about 25% larger than JAINCOMP-C. Preliminary design studies have been made of JAINCOMP-type computers for real-time computation and simulation.

New components include a small magnetic amplifier weighing 0.007 oz. and capable of putting out a 1.5-watt pulse of 5 microsecond duration every 25 microseconds; a completely

potted 2.5 microsecond delay line weighing 0.63 oz.; and a shaft-position digitalizer capable of giving very high accuracy (in angle measurement) in 0.1 millisecond or less.

CONSOLIDATED ELECTRONIC DIGITAL COMPUTER MODEL 30-201

Since the last Digital Computer Newsletter release on the Consolidated Computer (April 1952), the design has been completed, and construction has been progressing on the first instrument. By 1 March 1953, all commands were checked out on the laboratory test assembly of the arithmetic and control circuits. On 9 March tests were begun on the magnetic-drum memory system, which stores 4000 words of 10 decimal digits and sign, and has also 80 words of quick-access memory. After both sections are separately checked, it is planned to couple them together to form an integrated computer on about 15 April. Test and diagnostic routines, subroutines, and various problems are now being coded and placed on tape by the Machine Operation Section.

The prototype, which will be essentially the same as the laboratory test model but housed in a cabinet, is under way concurrently and should be complete about May or June 1953. It is planned to retain this machine at Consolidated for application problems.

The input to these first two computers—the laboratory test model and the prototype—will be by means of photo-electrically read perforated paper tape. Binary-coded decimal digits are read in at the rate of 450 or more digits per second. Output is to a tape punch, with a speed of about 12 digits per second, or directly to a Flexowriter at about 8 digits per second. Development is under way on a coupling unit to permit use of IBM cards as the input-output medium.

THE ERA 1103 COMPUTER

The Engineering Research Associates, Division of Remington Rand Inc., 1902 West Minnehaha Avenue, St. Paul W4, Minnesota, has announced a new general-purpose computer system named the 1103. Details will be published in a forthcoming Newsletter.

THE RAND CORPORATION COMPUTER

The Rand Corporation, 1700 Main Street, Santa Monica, California, is constructing for its own use a large, general-purpose, digital, scientific computing machine, patterned after the Princeton machine. The main frame is completed and partially wired. All registers, adders, digit resolvers and about one third of the control are constructed and tested.

A 10-digit prototype version of this machine, capable of performing additions and right or left shifts, is in operation. In the near future a 128-word Selectron memory will be added to it for further tests. The 256-word Selectron memory for the large machine will follow soon after.

Plans for a drum memory and for the console are completed. Power supplies and refrigeration equipment will be installed and put into operation within a few months. Arithmetic unit testing is scheduled for late spring.

ABERDEEN PROVING GROUND COMPUTERS

The following table gives a summary of the utilization of the three high-speed digital computers at the Ballistic Research Laboratories of the Aberdeen Proving Ground during the calendar year 1952. Figures for the ORDVAC and EDVAC cover the 39 weeks beginning 7 April 1952.

Engineering time is classified as scheduled or unscheduled. Scheduled engineering is that time regularly scheduled in advance each week for servicing or engineering changes. This includes the bad as well as the good test time used to determine if the machine is ready for

problem operation. Unscheduled engineering is all other engineering t[illegible]pare the machine for problem operation and includes both good and bad tes[illegible].

The total available time is divided into three parts. "Problem [illegible]cking" time includes also the good test time used to determine whether the m[illegible] in good operating condition while these functions or a problem is in progress. [illegible] is time spent in productive output. "Idle" time is that in which the machine is known to be in good operating condition and is attended by a maintenance crew but not in use on problems. "Total machine time" does not include standby time when no attempt is made to operate or service.

	Average Machine Week in Hours		
	ORDVAC	EDVAC	ENIAC
Scheduled Engineering	23.8	34.4	12.5
Unscheduled Engineering	27.2	70.4	35.6
Problem Set Up and Code Checking	39.1	23.3	20.4
Production	29.4	21.7	67.1
Idle	26.3	2.4	3.7
Total Machine Time	145.8	152.2	139.3

ENIAC

The Burroughs Research Division has completed, at Philadelphia, a 100-word static magnetic-memory under Army Ordnance Corps commission for use with the ENIAC at the Ballistic Research Laboratories, Aberdeen Proving Ground. Its speed is 50,000 ten-decimal-digit numbers per second.

DATA PROCESSING AND CONVERSION EQUIPMENT

TELEDUCER

Telecomputing Corporation, 133 East Santa Anita Avenue, Burbank, California has developed the "Teleducer," a device which converts dc voltages into the corresponding digital representations.

The Teleducer reads out upon demand, starting from a reset condition and taking 0.8 second or less to reach a balance. Its digital output is then available for recording. Its accuracy is 0.1% of full scale. The three-decimal-digit output is in the form of contact closures. Since it is a bridge-balancing device, the input impedance at balance is essentially infinite. Its maximum sensitivity is 20 microvolts per unit increment or 20 millivolts full scale. The sensitivity is continuously variable down to 1 millivolt per unit increment.

SADIC

Consolidated Engineering Corporation's Type 33-102 SADIC Analogue-to-Digital Converter is a self-balancing Thompson-Varley potentiometer. Its average balancing and conversion time is one second. The full-scale input signal of 10 volts is divided into 1000 equal steps, providing 0.1% accuracy. SADIC's companion Type 1-121 Amplifier accepts positive or negative signals within the range of 1 to 64 millivolts with gain adjustable for full-scale output of 10 volts for such input signals. Thus data-processing systems incorporating these units are capable of sensing and automatically digitizing a 1-microvolt change in an analogue signal. The 3-digit numerical value is available both as contact closures and as a visual light display.

BENSON LEHNER INCREMENTAL PLOTTER

The Benson-Lehner Corporation has announced its Incremental Plotter, an accessory for the Computer Research Corporation Model 105 Digital Computer, which permits preparation of punched tapes and plotting and reading curves.

The Incremental Plotter can plot a curve on an area 11" x 17" from a single tape input, each signal from the pulsing unit advancing the plotter one increment (0.02 in.) in abscissa and advancing the tape reader one step. The tape reading is then fed to the plotter as an increment in ordinate. The plotter can also operate from increments in both abscissa and ordinate specified by separate tapes, at minimum rate of 10 pulses per second.

The device is capable of reproducing punched tapes, and it can prepare tape or provide input to the computer from curves placed on the plotting table. The pen carried on the intersection of the two crossbars, is for this purpose, replaced by a photoelectric line follower. The maximum permissible slope of the curve is 1. Output pulses are of 40-volt amplitude, 4-microsecond duration, and less than 1-microsecond fall time. In operating from the output of the computer, it responds to pulses of 14 volts amplitude and 4 microsecond duration.

Benson-Lehner has also developed a Reversible Tape Reader, which, on command from the computer, will advance or go back one step, reading the tape to the computer, positively or negatively respectively, to provide increments in a dependent variable.

COLEMAN DIGITIZER

The Coleman Engineering Company, 6040 W. Jefferson Blvd., Los Angeles 16, California, has developed the "DIGITIZER," a device for converting rotational shaft positions into electrical contact settings. The DIGITIZER may be provided with lamp bank readout. The same set of digitalizing contacts is used for a given lamp bank readout as is used for the corresponding automatic readout, in order that there can be no hidden disparity between the signals observed at the light bank and the signals transmitted to the automatic recording system.

The contacts are separated from the brushes during rotation of the input shaft, providing extraordinarily low torque-to-drive and virtual elimination of contact and brush wear. The standard production models can be operated normally at upwards of 18,000 rpm at the units decade (corresponding to 3000 digits per second). Torque to start rotation of the units decade input shaft is approximately 0.005 inch-ounces. Retraction of the contact assembly is accomplished by solenoid actuation. The solenoid-energizing circuits may be either tied in with, or independent of, the drive system which positions the input shaft. Standard production models are offered in three-, four-, and five-decade versions. Six decades and over can also be furnished. The four-decade model occupies an envelope measuring approximately 5" by 5" by 1-1/8" thick, including contact-retracting solenoids. The weight of this unit is slightly over two pounds.

FERRO-RESONANT FLIP-FLOP

A smaller, more rugged package requiring only 1/3 cubic inch for mounting space is featured in the new Model 133 Ferro-Resonant Flip-Flop recently announced by the Computer Research Corporation. The new package has reduced the ferro-resonant flip-flop size by one-third, and has reduced cost by fifty per cent.

It can deliver more than 90% of the input energy as usable output, since copper and core loss are the only source of power consumption. The use of non-dissipating reactive elements virtually eliminates the problem of heat dissipation. Other features include operating at frequencies up to 100 kc, high power gain, immunity to high acceleration and shock, and the ability to withstand wide temperature, humidity, and pressure changes.

LOGRINC AUTOMATIC GRAPH FOLLOWERS

The Logistics Research Inc., 141 South Pacific Avenue, Redondo Beach, California, has developed two new automatic graph followers. The Logrinc Digital Graph Follower consists of a combination of the Digital Plotter and the necessary photo-electric and electronic components for automatically following curves and converting the data into electrical impulses. The follower is suited as an input and output device for digital differential analyzers such as the CRC-105 or the MADDIDA-44A and may be used with either of these particular machines without additional equipment. Working as an output device, it will plot any two variables against one another, each electrical impulse received causing an incremental movement of the pen. As a follower, it will handle any continuous function, including those which have infinite slopes. The drum holds paper sheets 12 x 18 inches.

The follower can follow the curve at a maximum rate, exceeding 20 steps a second, and deliver electrical impulses corresponding to incremental movements on both axes, or it can allow motion on one axis to be externally controlled. In this latter mode of operation, incremental changes of 1/100 or 1/64 inches along one axis are fed from an external source, and the automatic follower produces electrical impulses to correspond with resulting motion on the other axis.

The electronics section of the follower is housed in a caster-mounted cabinet, approximately 30 inches wide, 15 inches deep, and 30 inches high. The cabinet is designed to support the plotting drum at a convenient height. For rapid preventive maintenance, all electronic components are contained in plug-in units which are mounted on a swing-out chassis.

The Logistics Research Inc. three-dimensional model has the same specifications as the standard Logrinc Automatic Digital Graph Follower, except that it is designed to handle functions of two variables. Families of curves on a single sheet may be placed on the drum, and a separate externally controlled input will cause the follower to switch automatically from one curve to another. This separate input or "Z axis" control is also incremental and bi-directional. Incoming pulses will cause the follower to change to an adjacent curve of the family in either direction. Impulses corresponding to incremental movements in changing from one curve to the next are transmitted through the regular output channel.

AVAILABILITY OF DIGITAL COMPUTING SERVICES

Key: (a) Name and Address of Contact
(b) Facilities and their Location
(c) Coding and Mathematical Services
(d) To Whom Available

(1) Purdue University

(a) A. J. Perlis, Department of Mathematics, Purdue University, Lafayette, Indiana.

(b) Desk calculators, IBM equipment including a CPC, and complete auxiliary equipment. A magnetic-drum digital computer is expected in late 1953, which will be located in the Statistical Laboratory at Purdue.

(c) Available.

(d) No restriction.

(2) Benson-Lehner Corporation

(a) H. J. Rounds, Jr., Data Reduction Division, Benson-Lehner Corp., West Los Angeles 64, California.

(b) Equipment for analyzing oscillograms, dial and ballistic film, etc.

(c) Available.

(d) No restriction.

(3) Moore School of Electrical Engineering

(a) Robert E. Schultz, Moore School of Electrical Engineering, University of Pennsylvania, 200 S. 33rd Street, Philadelphia 4, Pennsylvania.

(b) A Differential Analyzer, a Card-Programmed-Calculator, and desk calculators.

(c) Available.

(d) No restriction. Preference given to proposals of a research nature.

(4) Computer Research Corporation

(a) R. E. Sprague, Computer Research Corporation, 3348 W. El Segundo Boulevard, Hawthorne, California.

(b) CADAC 102-A (available after July or August 1953).

(c) Available.

(d) No restriction

COMPUTER AND NUMERICAL ANALYSIS COURSES

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

An intensive two-week summer program on computers and computer applications will be carried out under the direction of Professor Charles Adams, assistant professor of digital computers, who is in charge of general applications of the MIT Computer Laboratory. The program will include an introduction to digital-computer coding and a survey of existing computers, applications, numerical methods, and advanced programming techniques. It will be supplemented by group discussions and by demonstrations and practice on the MIT Whirlwind I Computer.

COMPUTER RESEARCH CORPORATION

Regular scheduled courses in programming and maintenance for general-purpose digital computers, with emphasis on the CADAC 102-A, will be offered at the Computer Research Corporation, 3348 W. El Segundo Boulevard, Hawthorne, California. These courses will begin about May 1953 and will be offered approximately every two months. Programming and maintenance courses will be conducted simultaneously with one week of overlapping material. It is expected that the course will last four or five weeks. In addition, at least one programming course on the CRC 105 will be given in the spring or summer of 1953. Inquiries on these courses should be directed to the CRC.

NOTICES

DCN NEWS ITEM

The Computer Branch of the Office of Naval Research, Washington 25, D. C., solicits news items for inclusion in the Digital Computer Newsletter. Material should be received by 10 March, 10 June, 10 September, or 10 December, for publication in the Newsletter of the following months.

JOINT COMPUTER CONFERENCE

The annual joint computer conference, sponsored by the Association for Computing Machinery, Institute of Radio Engineers, and American Institute of Electrical Engineers, will be held this year in Washington, D. C., at the Hotel Statler, 16th & K Streets, N. W., on 8, 9, and 10 December 1953.